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AGRICULTURAL MEMORANDUM NO 838

# COMPARISON OF GLASSHOUSE CROP WATER REQUIREMENTS DERIVED FROM SOLARIMETER RECORDS AT EFFORD EHS AND FROM MORECS GRID SQUARE VALUES

In Agricultural Memorandum No 570 Forsdyke compared the water requirements of glasshouse crops at Efford EHS derived from solar radiation measurements made by a Kipp solarimeter and from sunshine records. He found that the values were not grossly different and suggested that the differences were less than the accuracy with which growers could measure the water applied.

In March 1977 values of potential transpiration for grid squares became available. These values were calculated by MORECS (X) - the Meteorological Office Rainfall and Evaporation Computing System (Experimental Version). Because values of water need calculated from solarimeter readings were still being supplied by Efford it was decided to see what sort of relationship, if any, existed between the 2 sets of figures. The comparison was not ideally matched because the MORECS week ended on a Tuesday and that for Efford on a Thursday. Efford lies in square 182 which includes the Isle of Wight and Southampton but it is essentially a 'coastal' square.

The values of P/T for the grid squares had been calculated assuming a composite albedo for the grid square whereas in the previous comparisons a complete cover of a green crop such as grass was assumed. This meant that the values for the grid squares had to be adjusted by a factor of 0.9. Diagrams of comparisons between the adjusted and original values and the figures obtained from Efford are appended. From the end of March 1978 some adjustments were incorporated into the MORECS programme which is now Operational, and among the various outputs are grid square values for grass. A comparison of these figures with those from Efford is also appended.

It was expected that there might be large differences between the figures if only because the MORECS values included a contribution from the wind term, and that whereas the comparison done by Forsdyke showed that the values derived from the solarimeter were slightly larger than those derived from sunshine the reverse might be the case in the present comparison. In the event, in the 'summer' period (April-September) there were 2 more occasions when the values from the solarimeter were larger than the grid square values compared with occasions when the grid square values were the larger; overall the mean difference between grid square and solarimeter values was - 0.40 mm per week. If those pairs which might be described as 'rogues' are eliminated the mean difference is - 0.05 mm per week. In the 'winter' (or period of short days) there were 4 more occasions when the grid square values were larger than when the solarimeter values were larger; the mean difference was 0.18 mm per week. When one pair of rogues is removed the difference is - 0.07 mm per week. There is, however, a good deal of variability from week to week which this treatment conceals and a table of the distribution of the differences probably describes the relationship better. In the table overleaf it may be seen that in summer (26 weeks) all but 3 of the differences lay between + 3 and - 3 mm per week, and over the 56 weeks examined all but 4 of the differences lay between + 4 and - 4 mm per week which converted to the units used in Agricultural Memorandum 570 are + 0.017 and - 0.017 and + 0.023 and - 0.023 inches per day respectively.

DIFFERENCES BETWEEN WEEKLY GRID SQUARE AND SOLARIMETER VALUES OF POTENTIAL TRANSPIRATION - 4 MARCH 1977 TO 30 MARCH 1978

GRID SQUARE MINUS SOLARIMETER VALUES mm

| | -7.0 to -6.1 | -6.0 to -5.1 | -5.0 to -4.1 | -4.0 to -3.1 | -3.0 to -2.1 | -2.0 to -1.1 | -1.0 to -0.1 | 0.0 to 0.9 | 1.0 to 1.9 | 2.0 to 2.9 | 3.0 to 3.9 | 4.0 to 4.9 | 5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 'winter' | | | | 4 | 1 | 6 | 2 | 7 | 5 | 2 | 2 | | | | 1 | 0.18 |
| 'summer' | 2 | | | | 5 | 3 | 4 | 4 | 3 | 4 | | | 1 | | | 0.40 |
| Total | 2 | - | - | 4 | 6 | 9 | 6 | 11 | 8 | 6 | 2 | - | 1 | - | 1 | 0.09 |

The points are shown on figures 1 to 3 on which the appropriate regression lines have been drawn. Figures 4 to 6 show the relationships between the unadjusted values and solarimeter values. Figure 7 shows the relationship so far using the amended MORECS programme.

In view of the modifications which have been made to the MORECS programme it is perhaps inappropriate to comment too fully on the results. As might have been expected when the days were short the agreement between the 2 sets of figures was less good than during the long day period of the year, but this did not worsen the relationship when the 56 weeks were treated together. It is unfortunate that 3 out of the 4 'rogue' pairs occurred during the summer when water demand by plants is high, and 2 of the pairs occurred within a 3 week period in May in which all the differences were in the same sense - the grid square values being the smaller and amounting to about 16 mm on aggregate. Apart from this period, when use of grid square values might have led to significant underwatering, it would have been just as satisfactory to have used the grid square values as those obtained from the solarimeter, though there might have been a little overwatering in winter.

It is intended that the comparison should be continued during the rest of this season and a further note will be issued in due course.

My thanks are given to the staff at Efford EHS for supplying the weekly data.

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Meteorological Office
Bristol

July 1978

Any comments and suggestions about this paper should be sent to the author.

Ref: D Forsdyke: Comparisons of glasshouse crop water requirements derived from sunshine and solarimeter records at Efford Experimental Horticulture Stations - Agricultural Memorandum 570.

A COMPARISON OF THE WATER REQUIREMENT CALCULATED FROM THE SOLARIMETER FOR GLASSHOUSES AT EFFORD WITH MORECS(X) GRID SQUARE VALUES ADJUSTED TO ALBEDO FOR GRASS. [EXPRESSED IN MM]

PERIOD 4TH TO 31ST MARCH 1977 AND 30TH SEPTEMBER 1977 TO 30TH MARCH 1978

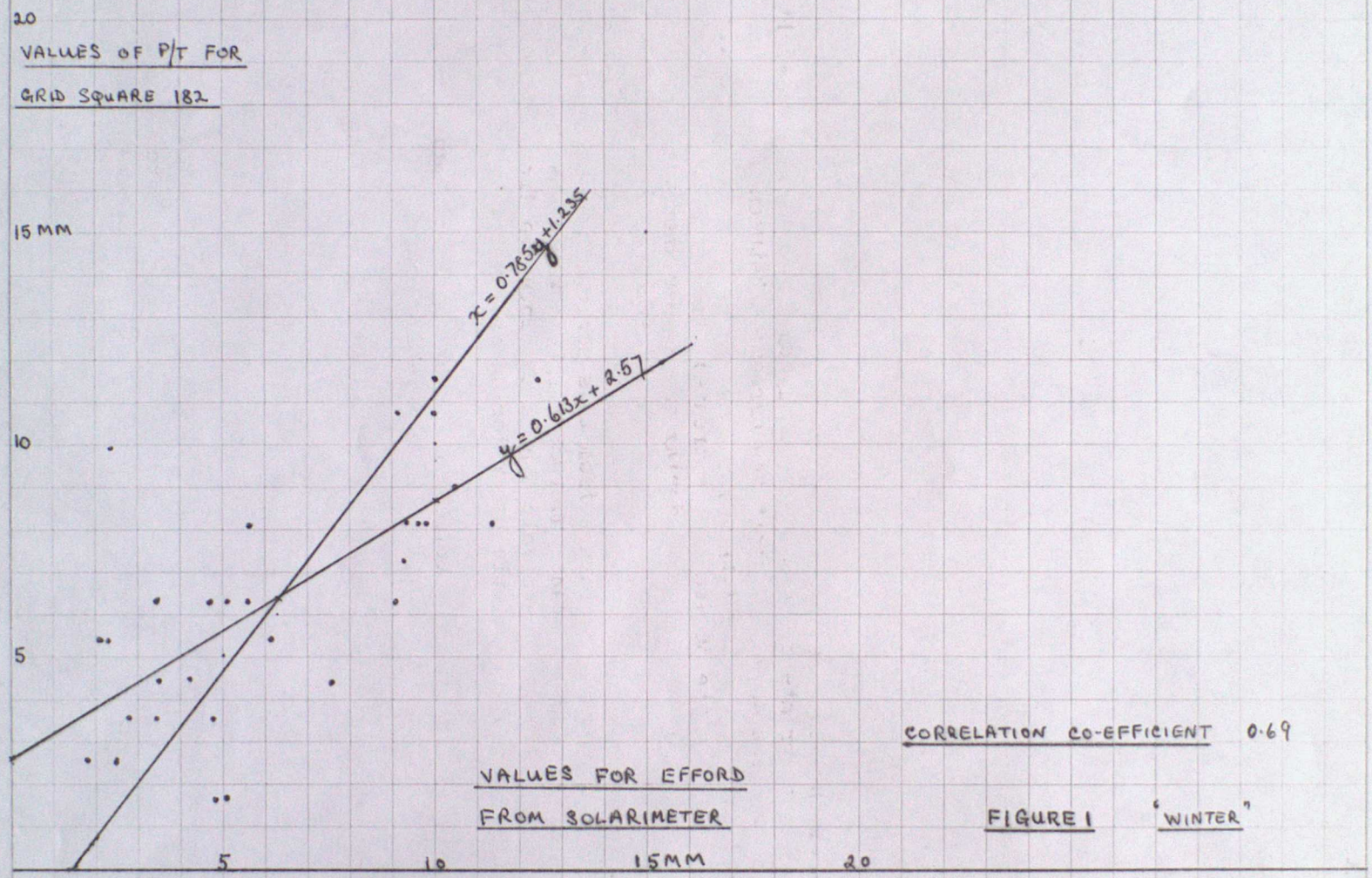



FIGURE 1 "WINTER"

A COMPARISON OF THE WATER REQUIREMENT CALCULATED FROM THE SOLARIMETER FOR GLASSHOUSES AT EFFORD [EXPRESSED IN MM] WITH MORECS(x) GRID SQUARE VALUES ADJUSTED TO ALBEDO FOR GRASS PERIOD 1ST APRIL TO 29TH SEPTEMBER 1977

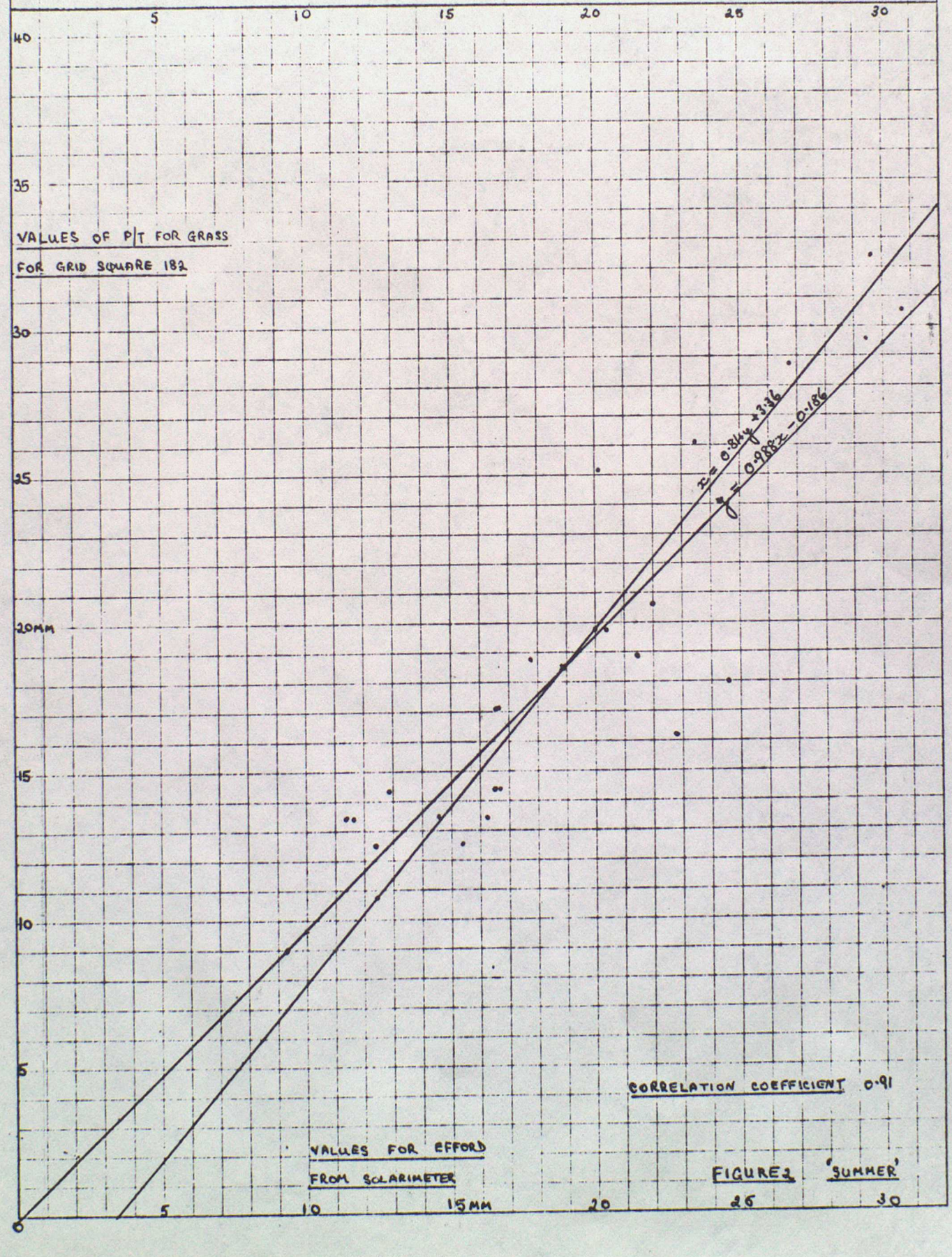

VALUES OF P/T FOR GRASS FOR GRID SQUARE 182
VALUES FOR EFFORD FROM SOLARIMETER
20MM
15MM
y = 0·844x + 3·36
x = 0·988y − 0·186
CORRELATION COEFFICIENT 0·91

FIGURE 2 'SUMMER'

A COMPARISON OF THE WATER REQUIREMENT CALCULATED FROM THE SOLARIMETER FOR GLASSHOUSES AT EFFORD [EXPRESSED IN MM] WITH MORECS(2) GRID SQUARE VALUES ADJUSTED TO ALBEDO FOR GRASS PERIOD 4TH MARCH 1977 TO 30TH MARCH 1978

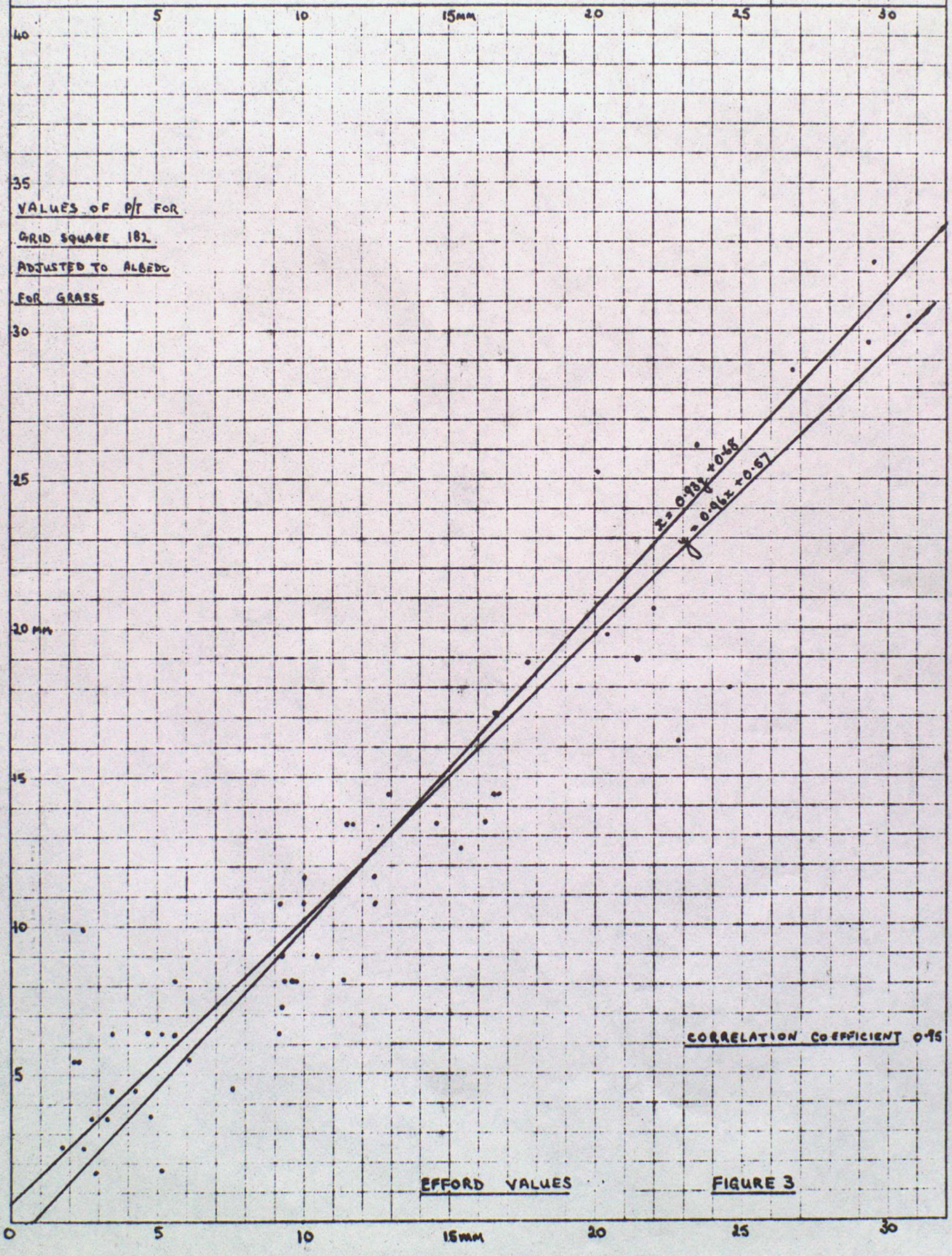


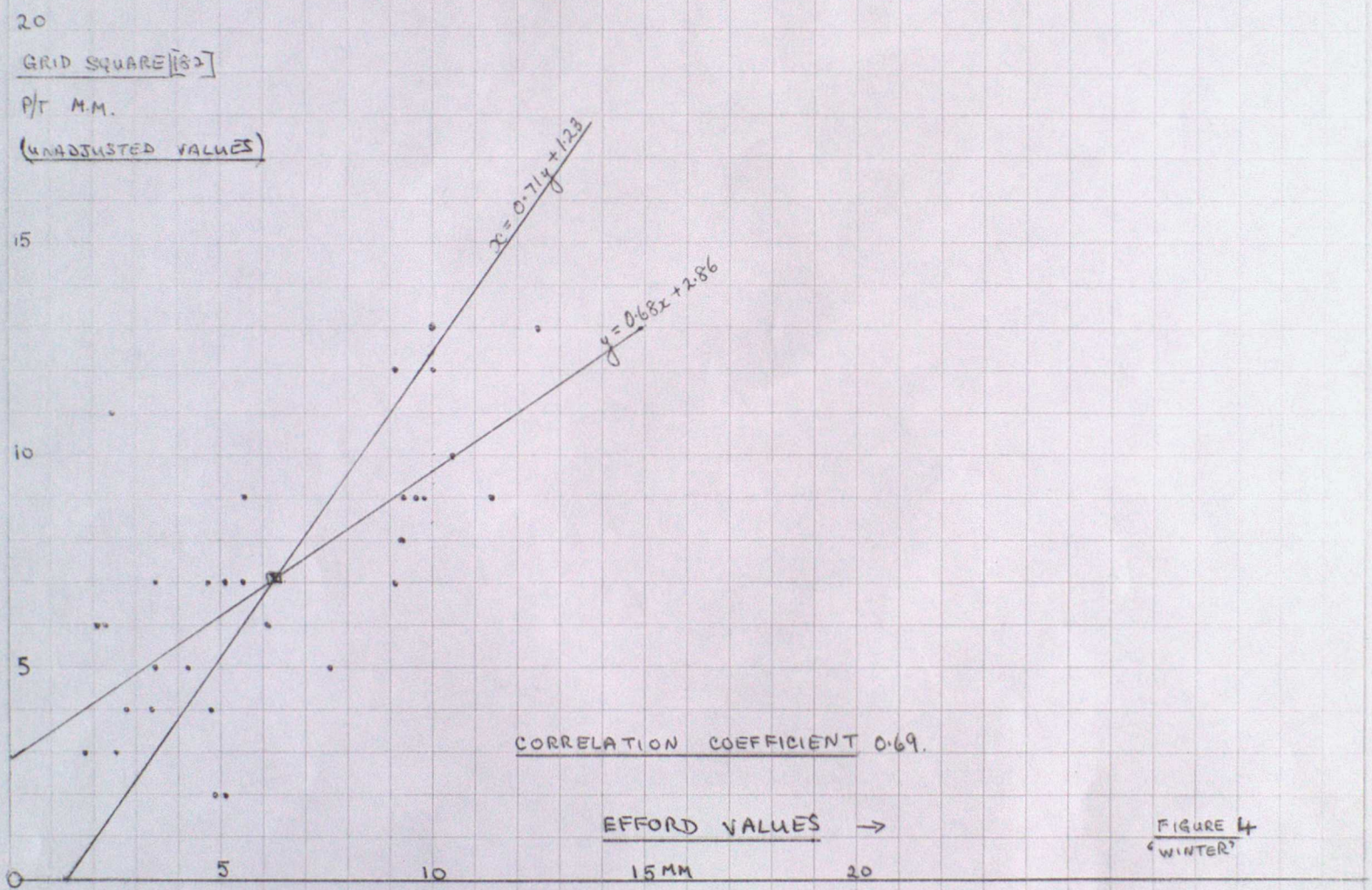

FIGURE 3

EFFORD GLASSHOUSE WATER REQUIREMENT CALCULATED FROM SOLARIMETER [EXPRESSED IN MM]

V. MET. O. GRID SQUARE [182] VALUES

PERIOD 4TH TO 31ST MARCH 1977 AND 30TH SEPTEMBER 1977

TO 30TH MARCH 1978




CORRELATION COEFFICIENT 0·69.

EFFORD VALUES →

FIGURE 4
'WINTER'

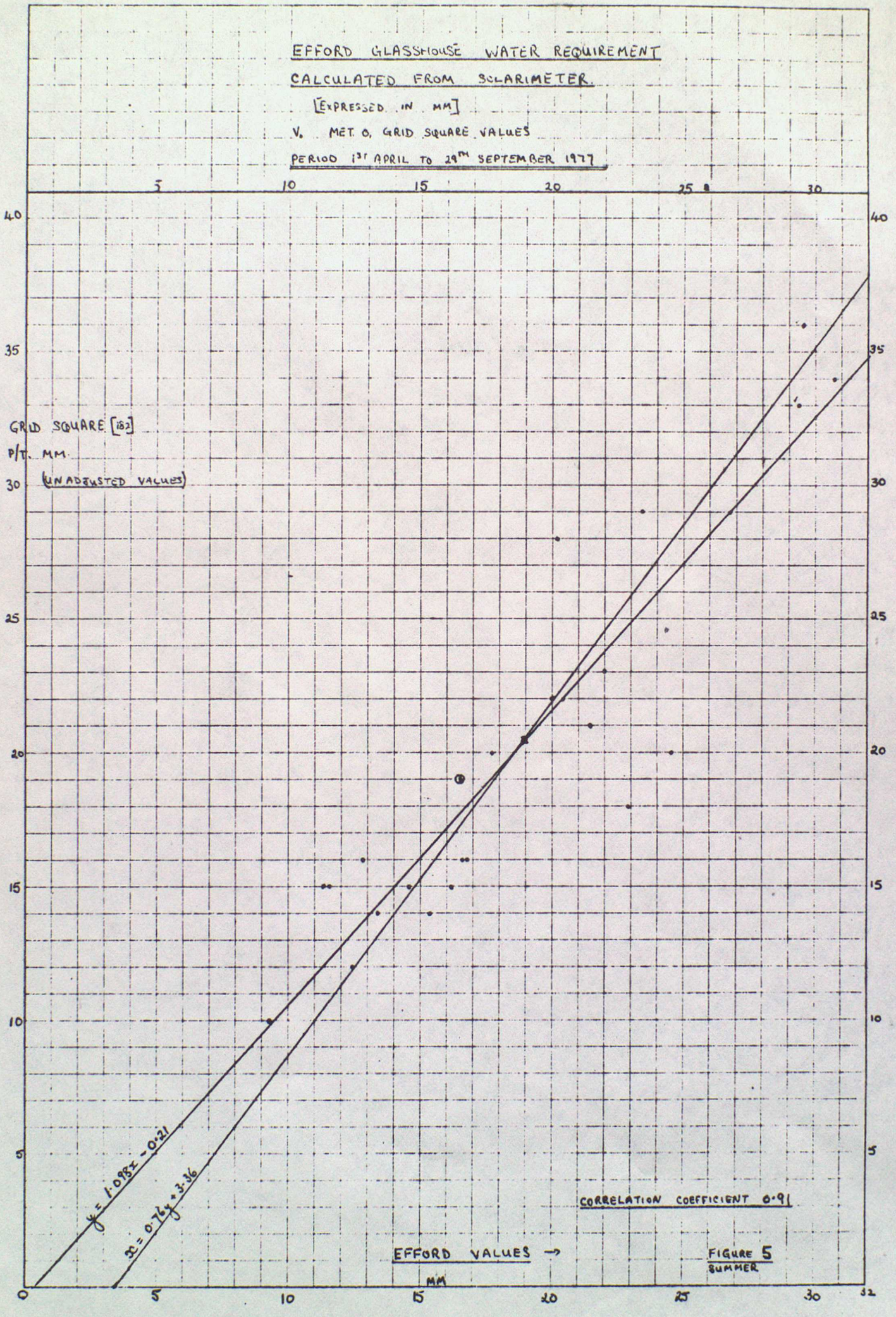



FIGURE 5
SUMMER

A COMPARISON OF THE
EFFORD GLASSHOUSE WATER REQUIREMENT
CALCULATED FROM SOLARIMETER
[EXPRESSED IN MM]
WITH MET. O. GRID SQUARE VALUES
PERIOD 4TH MARCH 1977 TO 30TH MARCH 1978

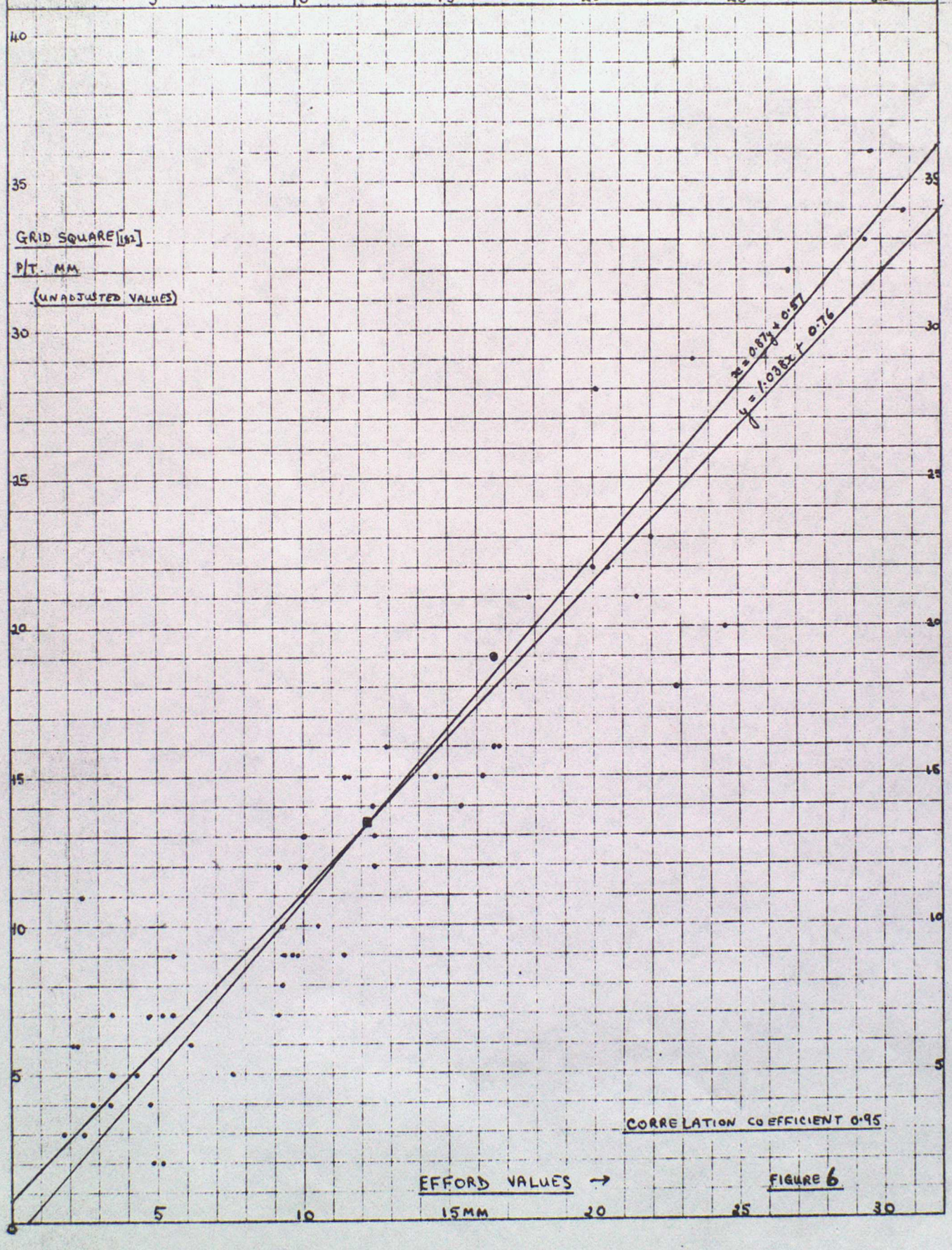



FIGURE 6

A COMPARISON OF THE WATER REQUIREMENT CALCULATED FROM THE SOLARIMETER FOR GLASSHOUSES AT EFFORD. [EXPRESSED IN MM] WITH MORECS GRID SQUARE VALUES FOR GRASS PERIOD 31ST MARCH TO 6TH JUNE 1978

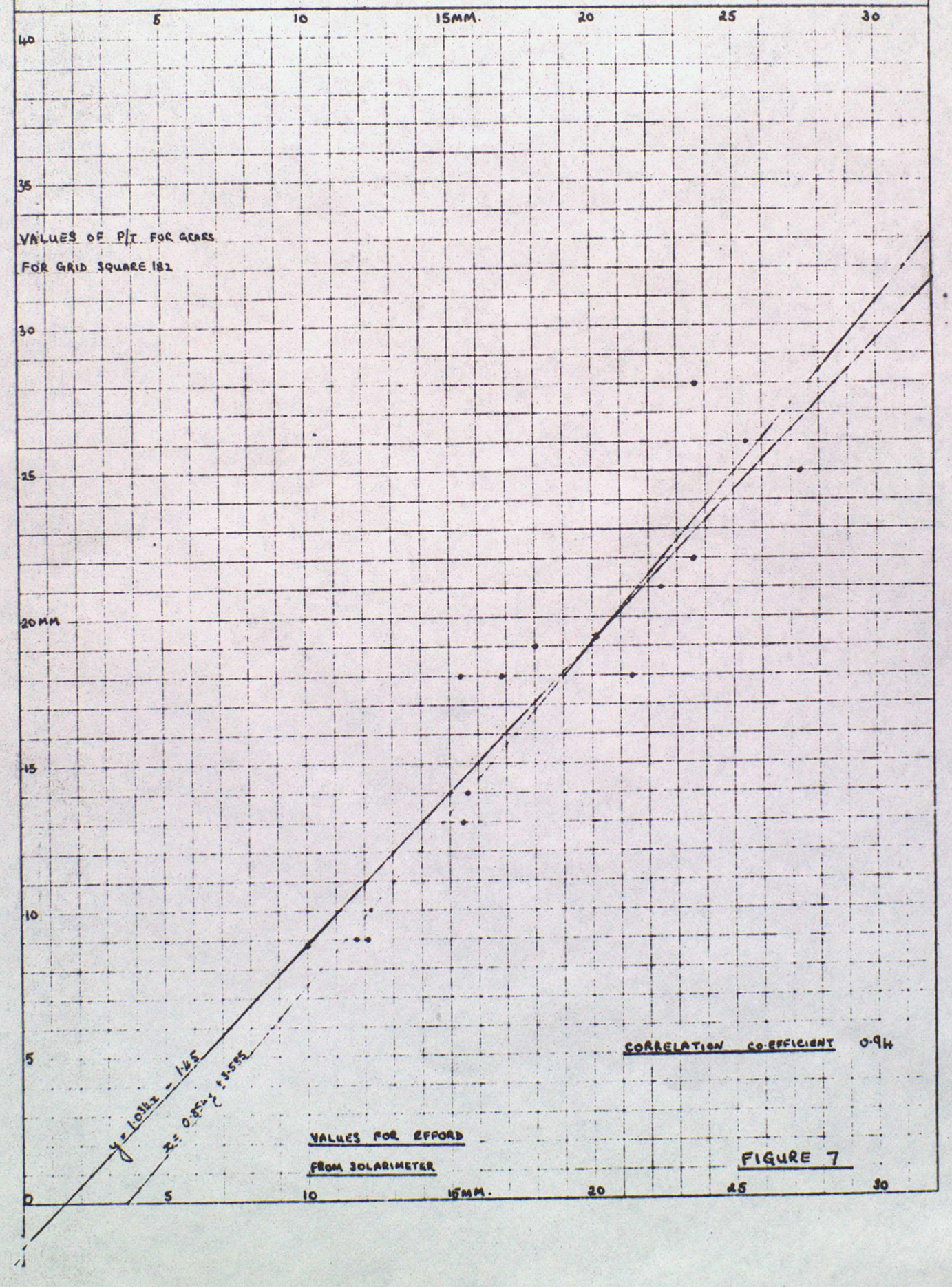



FIGURE 7